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Introduction: Economics of Betting Markets

by D.A.Peel

Economists have long been interested in the economics of betting markets as exemplified by the excellent survey articles by Sauer (1998) and Vaughan Williams (1999). This is perhaps not surprising given that in many countries the majority of persons gamble often with large stakes.[1] For instance 68% of the population of the UK had participated in some form of gambling activity within the past year in the UK (48% excluding people who had only gambled on the National Lottery Draw). (See British Gambling Prevalence Survey 2007). Also the amount of money spent on gambling activities is increasing in many countries. For example the amount retained by gambling operators in the UK after the payment of winnings, but before the deduction of the costs of the operation was £9.8 billion a 36% increase in nominal terms since 1999. See British Gambling Prevalence Survey 2007).

The last few years has seen an increase in academic literature on the economics of gambling with new specialist journals formed. This probably reflects the availability of data sets and the increasing importance of the gambling sector.

This issue of Applied Economics is given up to 11 papers that reflect current work in this area.

The standard expected utility model is of course inconsistent with gambling at actuarially unfair odds. Some still add a non-pecuniary motive (such as excitement or entertainment), that compensates for the expected negative pecuniary returns to that model to explain gambling. However whilst it is undoubtedly the case that non-pecuniary returns are relevant for some who engage in gambling, the hypothesis *per se* is unattractive, because it is inconsistent with *apriori* reasoning[2], with the fact that a majority say they gamble to make money[3] and with other experimental evidence[4].

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[1] For instance, Bruce and Johnson (1992) report average stakes of £22.63 on race horse favorites. Strumpf (2003) reports that average bet size averaged in excess of $1000 in a study of six illegal bookmakers.

[2] Friedman and Savage (1948) and Markowitz (1952) in their seminal papers provide a critique of the entertainment rationale. For instance, Markowitz notes that if the utility of a gamble is the expected utility of the outcomes plus the utility of playing the game then, for given fair odds, the smaller the amount bet, the higher the expected utility. This implies millionaires should play poker for pennies and no one should purchase more than one lottery ticket.

Cumulative Prospect theory (CPT) developed by Kahneman and Tversky (1979) and Tversky and Kahneman (1992) can explain a variety of experimental results inconsistent with expected utility theory and also optimal gambling on long shots.

In the first paper Cain, Law and Peel show that an alternative parametric specification of CPT enables the CPT model to explain gambling on all outcomes including odds on favorites.

One possibly problematic feature of CPT is that betting on long shots at unfair odds is induced by "extreme" probability distortion. This probability distortion implies that the subjective expected returns sometimes run into hundreds of percent. In order to explain the famous Allais (1953) paradox it is necessary to assume probability distortion. In paper two Peel, Zhang and Law introduce a small degree of probability distortion into the Markowitz (1952) model of expected utility, of which the value function in CPT is a special case. They show that this model can explain the Allais experiments as well as gambling outcomes without assuming subjective rates of return run into hundreds of percent.

In paper three Bhattacharyya and Garrett develop a model based on an extension of that of Friedman and Savage (1948) model to explain state lottery games. The utility function proposed by Bhattacharyya (2003) is concave for wealth below the current wealth of the agent and it is convex above the current wealth of the agent. Their model implies that lottery players trade-off expected return for skewness of return. Carefully carried out empirical analysis of two interesting data sets appears to give support to their model.

[3] When surveys ask gamblers why they gamble, a majority (approximately 42%-70%) cite financial reasons: 'to make money' (see, for example, The Wager (2000).)

[4] Many experimental results conflict with the standard expected utility model. An excellent discussion of some of this experimental evidence can be found in Starmer (2000).

However the precise structure of a lottery ticket implies a relationship between expected return and the higher moments.[5] Such a relationship can also be derived from the utility function. Both should perhaps be explicitly included in future analysis. Also their model is similar to a restricted version of the Markowitz model and appears to imply unbounded stakes and preference for one-prize lottery tickets. It would surely be interesting to build on their analysis employing alternative models of utility, which do not have these implications.

In paper four Deck, Lee, and Reyes estimate the degree of risk aversion of contestants appearing on *Vas o No Vas*, the Mexican version of *Deal or No Deal*. They find substantial evidence of risk aversion. However their estimates are lower than previous estimates based on game shows. They also find a considerable variation in risk attitudes, with a few people being extremely risk averse while others are risk loving. It would perhaps be interesting to rework the analysis employing a non-expected utility approach.

In paper five Farrell and Forrest consider the interesting issue of the extent of displacement effects across gaming products. Employing Australian data they estimates a state level (fixed effects) panel data model, exploiting the intra-state differences in the portfolio of gaming products available, to estimate the extent of displacement effects across the gaming sector. In particular they examine whether sales of lotto and lotto-style products in Australia were displaced by the introduction and growth of large casinos and by the spread of casino-style machine gaming within neighborhood hotels (pubs) and clubs. Their evidence suggests a potential for local casinos to divert significant sums from lotto and the causes it

[5] See Brockett and Garven (1998) and Cain and Peel, (2004). For instance for a 1 unit bet with odds o win probability p the relationship between the moments is given by

$$\mu^2\sigma^2 + \mu s - (\sigma^2)^2 = 0$$

$$\text{where expected return} = \mu = p(1+o),\ \text{variance} = \sigma^2 = \frac{\mu^2(1-p)}{p},$$

$$\text{skewness} = s = \frac{\mu^3(1-p)(1-2p)}{p^2}$$

skewness , s, is negatively related to expected return but there is no behavior implied.

funds. Their results are of relevance to the current policy debate in other countries such as the UK.

In paper six Benar and Jenkins develop a model that focuses on the implications for economic welfare of different taxation schemes for casinos, though it is assumed that casinos cater exclusively to foreign tourists. The model is applied to the situation in North Cyprus. They find that a tax on the turnover of funds gambled is an equally efficient to one that taxes the annual fixed costs of the casinos. However, because of the relative collection costs it might be welfare improving to maintain a low turnover tax, and use a tax on the annual fixed costs of the casinos to tax away the rest of the economic rents. Extension of their model relaxing the "foreigner" assumption would be of interest.

In paper seven Winter and Kukuk develop an innovative model that can explain the favorite longshot bias. The show that the favorite-longshot bias may be the rational answer of an honest audience to a simple, but highly lucrative cheating opportunity of insiders. The cheating takes the form of knowing that a horse will not win. Employing a large scale German data set they demonstrate that the pattern of the favourite-longshot bias changes as the opportunity of cheating vanishes.

In countries such as the UK insiders with such information have the option of laying the horse directly. It would be interesting to incorporate such elements into the Winter and Kukuk model.

Numerous papers have addressed the issue of whether gambling markets are efficient. The final four papers provide further evidence on various aspects of this hypothesis.

In paper eight Gramm, Mckinney and Owens employing a much larger data set than has been employed in many previous studies examine efficiency in multihorse 'exotic' wagers using data from U.S. racetracks. They find a favorite-longshot bias in exacta wagers but results are unclear for trifecta wagers.

In paper nine Graham and Stott develop a results-based probit model and an odds forecasting model to compare with the odds of UK bookmaker. They explicitly allowed for the impact of home advantage. They found that the bookmakers offer better odds on favorites but this favorite-longshot bias cannot be exploited by their statistical model.

In paper ten Vlastakis, Dotsis, and Markellos evaluate the performance of a Poisson count regression and that of a Support Vector Machine (SVM) (belonging

to the family of neural networks) in forecasting using IX2 and Asian Handicap odds data from the English Premier league. The modeling results show that while the SVM is only marginally superior on the basis of statistical criteria, it manages to produce out-of-sample forecasts with positive out-of-sample profits and thus suggests inefficiency.

However the sample size employed by the authors is relatively small and there is a need for replication of this methodology on larger samples and other data sets.

In paper eleven Forrest and Simmons examine whether sentiment plays in a part in the fixed odds setting process. They report new results for both Spanish and Scottish football that bookmaker prices appear to be appear to be influenced by the relative number of fans of each club in a match and that returns can be increased by employing this information. They point out that this mispricing could be a commercial decision. Again there is a need for replication on other data sets. Also the measure of sentiment might be sharpened. At the moment it is proxied by the difference in average home attendance in the previous season. In principle two well supported or two badly supported teams could have the same difference. It is not clear why the bookmaker should treat these type of matches in the same manner.

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